The proof of the addition theorem is not very satisfactory. The author proves the theorems for sin $(x+y)$ and cos $(x+y)$ for *acute* angles (using a revolving line of unit length, and so denoting the sines and cosines by lengths of lines instead of ratios, which seems a pity), and then says "it is a fact, however, that these formulæ hold for angles of any magnitude, positive or negative." This he illustrates by a couple of cases. Then, in the next section, he says "it was shown" that the formulæ hold good for all angles. The proof by projection now customary in the best English books would have been much more satisfactory.

The directions for solving trigonometrical equations are not altogether satisfactory, and would lead to difficulties in the case of such an equation as $\sin 3x = \cos 4x$. This part of the subject would need amplifying. The similar instructions for proving identities, though sometimes leading to rather heavy work, would always lead to success and be useful in the last resort, though not conducive to elegance.

The solutions of triangles are well explained, and there is a good chapter on the theory and use of logarithms and their applications to nautical and other problems, but one is sorry not to see the value of the characteristic given as the distance of the highest significant figure from the unit's place, plus or minus according as it is to the left or right. It is more fundamental and easier to remember than the old-fashioned method given in the text.

This part of the book finishes with a discussion of acute angles near 0° and 90°, and a collection of miscellaneous practical examples of the usual type, followed by a useful recapitulation of formulæ, with the pages on which they are proved.

The spherical trigonometry assumes some previous knowledge on the part of the reader, as far as the properties of the polar triangle, and one or two of the more advanced formulæ are quoted without proof. The chief features of this part are a good exposition of Napier's rules for right-angled triangles, and the use of the exterior angles (α, β, γ) in all the formulæ for oblique triangles, a most excellent innovation which the reviewer has advocated for many years, but has never before seen in a text-book. By this means all formulæ become dual without any change except the interchance between a, b, c and α, β, γ. It leads, perhaps, to a preponderance of obtuse angles in the practical applications, but the author in his logarithmic work, which is most excellently exemplified, disposes of them by the simple device of putting (n) to the logarithms of negative quantities, a method often used by practical computers, but not often seen in text-books. The book concludes with applications to astronomical and other problems, well explained and illustrated by good diagrams, with a fair number of examples for the student to solve.

(2) This volume completes the authors' plan of a course of mathematics for students of engineering and physics. The first chapter discusses infinitesimals, and defines differentials of functions of a single variable. Then come chapters on integration, with applications to geometry and mechanics, followed by special methods of integration applicable to partial fractions and trigonometric functions, including the use of reduction formulæ. Chapter viii. deals with simple differential equations, with mechanical and geometric examples illustrating their importance. Chapters ix. and x. deal with solid geometry; chapter xi. with partial differentiation; chapters xii. and xiii. treat of multiple integrals and applications, with carefully drawn diagrams well illustrating the building up of such integrals, in rectangular, polar, and cylindrical coordinates. Then follows an introduction to line integrals and their connection with surface integrals (Stokes's theorem). Chapter xv. is devoted to infinite series, giving the easier tests of convergence, followed by Maclaurin's and Taylor's series and an introduction to Fourier's series, and finishing with the evaluation of indeterminate forms. Chapter xvi. contains a short treatment of complex numbers and conjugate functions. The remaining chapters are devoted to differential equations, total and partial.

The whole book is very solid reading, but the explanations are well given, and when proofs are not fully given references are made to other treatises. The intention of the authors evidently is to take the students over as much ground as possible, and introduce them to all the functions and processes which they are likely to need in their scientific work. There are numerous problems for solution throughout the book, and there is an index at the end to facilitate reference. A. L.

ELEMENTARY PETROLOGY AND ORE FORMATION.

(1) *Rocks and Rock Minerals.* A Manual of the Elements of Petrology without the Use of the Microscope for the Geologist, Engineer, Miner, Architect, &c., or for Instruction in Colleges and Schools. By L. V. Pirsson. Fifth edition. Pp. vi+414. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 10*s.* 6*d.* net.

(2) *Genesis of Metallic Ores and of the Rocks which Enclose Them.* By B. Symons. Pp. xxxiii+494. (London: *The Mining Journal*, 1908.)

THE growing recognition of the economic uses of petrology and the increasing complexity of petrographic methods are rendering necessary the development of a less technical rock nomenclature for use in the field and by general geologists. No one who has acquired sufficient knowledge of petrology to determine the approximate chemical composition and qualities of a rock from a short study of a thin section is likely to discontinue the use of the microscope. The increasing number of students of mining, chemistry, engineering, and agriculture who have to study rocks, but have not much time to devote to the subject, is leading to the issue of special text-books on petrography without the microscope, and, thanks to its revelations, much can now be learnt from rocks by the examination of hand specimens.

(1) Prof. Pirsson's "Rocks and Rock Minerals" is the most advanced of the manuals of petrology without the microscope, but it may be recommended even to students who can use that instrument owing to its clear statement of the principles of petrogenesis and of the mode of occurrence of the sedimentary and

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igneous rocks. It summarises the characters of the chief rock-forming minerals, and of the origin and classification of rocks, and is illustrated by an admirable series of photographs and diagrams showing the field relations of igneous rocks. The author makes a useful protest against the appropriation by geologists of popular rock names in new and technical meanings. The term granite, for example, is used in the stone trade in its correct historical and etymological sense, which is entirely different from its use in geology. This system is as inconvenient, as Prof. Pirsson points out, as if botanists had re-defined the terms bush, tree, and shrub, limiting each to a particular species. Prof. Pirsson's protest is justified, and though some American geologists are using the familiar terms in their popular meanings, this reform has probably been proposed too late.

(2) Mr. Brenton Symons's "Genesis of Metallic Ores and the Rocks which Enclose Them" is also intended to appeal to the general elementary student, and is an attempt to explain the formation of ore deposits free from unnecessary technicalities. It is a book, however, of very different standard from Prof. Pirsson's; it is written by a practical engineer, who is keenly interested in the theoretical study of mining geology, but whose knowledge of the subject is a little unequal.

The book begins with a general introduction on geological principles, followed by a section on rock metamorphism; the third part of the book deals with the ore deposits. Though the author avoids so far as possible technical scientific terms, his text is often repellent by the abundant use of such Americanisms as cavations for spaces, such reformed spellings as "lentiles" for "lenticles," and vegetal for vegetable, and mining terms of only local value. The most valuable part of the book is its collection of diagrams of ore occurrences; the instances drawn from Cornwall are the most satisfactory, for some of his diagrams and views regarding ores in other parts of the world are a little out of date. Mr. Symons takes, moreover, an extreme position as to the genesis of ores. He has a great belief in the agency of geosynclinals, by which sediments are carried down to depths where they are melted, and then forced to re-ascend as igneous rocks into overlying strata; and though he describes many ores as plutonic, he appears to regard the vast majority of ores as having been derived from the destruction of Archæan rocks and precipitated in the sea. He says, on p. 381, "It has been already observed that nearly all the ores that can come within the reach of man have been derived from the Archean strata"; from these rocks, according to Mr. Symons, the metals are removed in solution and "precipitated on the bottom of the sea by chemical reactions that were principally set up by organic matter." He has no doubt, for example, that the gold in the reefs of Nova Scotia and the copper ores of Mansfeld were deposited in the rocks of those mining fields during their deposition in the sea. His view of the origin of crystalline rocks of most ores is shown by the following quotation.

"The presence of such minute proportions in all formations is natural, since the crystalline rocks, as far as known, were originally deposited as marine strata, and, consequently, retain some part of the minerals that were precipitated during sedimentation from the oceanic waters. The proportion of these metals appears to be just the same, whether districts are metalliferous or not" (p. 363).

This extract shows that the author adopts such an extreme position in regard to the genesis of ores that his book must be read with caution.

ZOOLOGICAL PRIMERS.

(1) *Die Säugetiere Deutschlands.* By Dr. C. Hennings. Pp. 174. (Leipzig: Quelle und Meyer, 1909.) Price 1.25 marks.

(2) *Korallen und andere gesteinsbildende Tiere.* By Dr. Walther May. Pp. iii+122. (Leipzig: B. G. Teubner, 1909.) Price 1.25 marks.

(3) *Die Fortpflanzung der Tiere.* By Dr. R. Goldschmidt. Pp. iv+124. (Leipzig: B. G. Teubner, 1909.) Price 1.25 marks.

(4) *Die Stammesgeschichte unserer Haustiere.* By Prof. Dr. T. Keller. Pp. iii+114. (Leipzig: B. G. Teubner, 1909.) Price 1.25 marks.

(5) *Biology.* By Prof. R. J. Harvey Gibson. Pp. viii +120. (London: J. M. Dent and Co., 1909.) Price 1s. net.

(1) THE most useful portion of this sketch of the mammalia of Germany lies in the synoptic tables placed at the head of each order; but these can hardly be considered as complete, since they do not include any account of the subspecies, which are of the greatest interest.

A complete list prefixed to this book would have made comparisons with the fauna of other countries a much easier matter. As it is, one has to search through the index in order to discover what forms are included in this work.

(2) Dr. May is a well-known writer on the anatomy of corals, and in this little work he brings together descriptions of a heterogeneous assemblage of animals, the common feature amongst which is the property of producing a hard exoskeleton, or of contributing otherwise by their remains to the formation of strata.

The question inevitably arising out of this treatment is, What determines the difference between, say, a soft anemone and an encrusted coral? To this Dr. May has, so far as we can see, no answer. Nevertheless, his book contains a good sketch of the various hypotheses accounting for the origin and formation of coral-reefs, and for this, if for nothing else, it is welcome. The corals and lamellibranchs appear to us the best parts of the work.

(3) Dr. Goldschmidt has undertaken to compress into a hundred small pages an account of the methods of animal reproduction, with especial reference to the number of the young, their state on hatching, their habits and adaptations. The work cannot be considered as really up to date, but the treatment is interesting, and the subject is one of such importance that we regret more space could not have been allotted to it. The illustrations are better than those of any other booklet of this series we have so far seen.

(4) In an earlier and larger work, published some

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